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INVENTION: LOW CURRENT ELECTRIC MOTOR PROTECTOR

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LOW CURRENT ELECTRIC MOTOR PROTECTOR

0001. Field of the Invention

This invention relates generally to motor protectors and more particularly to low current protectors for electrical devices such as compressors, transformers and small motors against overload and locked rotor.

Background of the Invention

0002. It is well known to provide reliable and inexpensive motor protectors that comprise a small housing in which is disposed a small current carrying thermostatic switch having a bimetal disc adapted upon the occurrence of certain thermal conditions to snap into and out of engagement with a stationary contact to respectively close and open an electrical circuit.

0003. In order to make such protectors quickly responsive to very small current levels, it is also known to provide a supplemental heater mounted in heat transfer relation with the disc. An example of this type of protector is shown and described in U.S. Patent No. 4,476,452 and comprises a metallic housing having an open end with a flange formed around the open end and a gasket and lid received on and clamped to the housing. A heat responsive electrical switch is disposed in the housing and is adapted to electrically connect and disconnect a current path through the housing and lid upon the occurrence of selected thermal conditions. The lid comprises two discrete, spaced apart portions, one portion having an elongated part extending therefrom to serve as a terminal and the other portion mounting a portion of the switch. A coil heater is electrically and mechanically connected between the spaced apart portions of the lid providing a protector particularly useful for fractional horsepower motors.

Summary of the Invention

0004. Although motor protectors made according to the above referenced patent are suitable for low current applications, there is a need to provide low cost protectors useful for low current applications having even more current sensitivity yet one which is mechanically robust and one which has increased reset times required for certain applications, such as protecting compressor motors.

0005. It is therefore an object of the present invention to provide a low current motor protector which overcomes the above noted limitations of the prior art. Another object of the invention is the provision of a low current motor protector which has improved current sensitivity, yet is mechanically robust regarding handling and vibration. Yet another object of the invention is the provision of a motor protector of the low current type which can be easily and accurately adapted for use with different electrical devices, such as compressors, transformers and small motors. Yet another object of the invention is the provision of a low current motor protector which is particularly conducive to low cost assembly techniques. Still another object of the invention is the provision of a low current motor protector which has an end of life, open circuit condition.

0006. Briefly, in accordance with the invention, a low current motor protector comprises a generally parallelepiped shaped metal housing defining a switch chamber which has an open end formed with an outwardly, laterally extending flange and in which a thermostatic switch is mounted. A window shaped gasket is received on the flange and first and second spaced apart lid parts are received on and clamped to the flange through the gasket electrically separated from the housing. The lid parts are each formed with a recessed contact shelf in alignment with and facing each other and adapted to receive end portions of a ceramic substrate. A thick film heater is disposed on the lower face surface of the ceramic substrate with contact portions disposed at opposite ends for receipt

on the contact shelves of the lid parts. The recessed positioning of the ceramic heater into the switch chamber results in placement of the ceramic heater in optimum heat transfer coupling with the thermostatic switch. According to a feature of the invention, the ceramic substrate increases the thermal mass of the heater to provide an extended reset time for the thermostatic switch. The thermostatic switch has a movable contact which is movable into and out of engagement with a stationary contact mounted on the lower or inside surface of one of the lid portions so that upon selected heating of the thermostatic switch by the ceramic heater the switch will cause the movable contact to move from a contacts engaged or closed position to a contacts disengaged or open position.

0007. The ceramic heater is received on the recessed seat formed by the contact shelves and is held in place by means of a mechanical clip extending across one of the lid portions which applies suitable force on the outer surface of the substrate against the contact shelves for good electrical engagement of the ceramic heater contacts therewith.

Brief Description of the Drawings

0008. Other objects, advantages and details of the novel and improved electrical motor protector of this invention appear in the following detailed description referring to the drawings in which:

0009. Fig. 1 is a top plan view of a motor protector made according to the prior art;

0010. Fig. 2 is a cross sectional view taken through line 2-2 of Fig. 1;

0011. Fig. 3 is a blown apart perspective of a motor protector made in accordance with a preferred embodiment of the invention; and

0012. Fig. 4 is similar to Fig. 3 of a modified embodiment of the invention but shown without the thermostatic switch.

Detailed Description of the Preferred Embodiment

0013. With reference to Figs. 1 and 2, a prior art low current motor protector comprises an oblong metallic housing 1 having a bottom wall 1a, sidewall 1b and a laterally, outwardly extending flange 1c at a free end of the sidewall. A gasket 2 of electrically insulating material is received on flange 1c and a lid 3 formed of spaced apart parts 3a, 3b are received on gasket 2. An extended portion 1d of flange 1c on opposed sides of the housing are bent over to clamp the lid parts 3a, 3b, through the gasket.

0014. Gasket 2 is formed with a window 2a aligned with a switch chamber defined by the sidewall 1b of the housing and a thermostatic switch comprising a snap-acting bimetallic member 4 has one end fixedly mounted on the bottom wall 1a of the housing and a free distal end mounting a movable electrical contact 4a movable into and out of engagement with stationary contact 3c welded to lid part 3a.

0015. A supplemental coil heater 5 has one end welded to lid part 3b and an opposite end welded to lid part 3a. Lid part 3b is formed with a terminal portion 3e and housing 1 is formed with a terminal 1e.

0016. Movable contact 4a is normally in electrical engagement with stationary electrical contact 3c thereby forming a current path between the terminals through bimetal 4 and coil heater 5; however, upon being heated to a selected temperature, for example, due to an overload current, disc 4 will snap to its dashed line configuration to open the circuit.

0017. Although the prior art motor protector described above is effective for certain applications, a protector having even more current sensitivity is desired in order to be useful in a wider market range. This requires increased resistance of the heater which could be obtained by decreasing the cross sectional area of the coil heater; however, this results in heater elements which are too fragile for normal handling. Further, in order to be useful in certain markets such as compressors having positive temperature coefficient (PTC) starting devices, a longer off or reset time is needed to allow appropriate cooling of the PTC starting device.

0018. These limitations are overcome by a protector made in accordance with the present invention. As shown in Fig. 3, a motor protector 10 comprises a metallic oblong housing 12 having a bottom wall 12a, sidewalls 12b extending away from the bottom wall and having a flange 12c extending laterally and outwardly from the free end of the sidewall.

0019. A thermostatic switch 14 is received in a switch chamber 12d defined by sidewalls 12b. Switch 14 comprises a bimetallic, snap acting disc 14a, known in the art, having one end 14b cantilever attached to the bottom wall 12a of the housing, preferably at an inwardly extending platform 12e, as by welding thereto using welding slug 14c. A movable electrical contact 14d is mounted at the free end 14e of the disc on the side thereof facing away from the bottom wall of the housing.

0020. An electrically insulating gasket 16, generally in a shape of a window frame 16a, is received on and covers flange 12c of the housing. The gasket has an extended portion 16b along two elongated opposite sides which are folded back toward the center of the window frame configuration into a generally V-shape in order to sandwich two opposed flange portions of the housing between layers 16a and 16b. Preferably, an additional portion 16c extends from extended

portion 16b for placement along the sidewalls 12b of the housing to ensure electrical isolation between lid parts, to be discussed, and the housing.

0021. A lid 18 comprises first and second parts 18a, 18b, respectively. Each lid part has a flat support portion 18c, 18d, respectively, lying in a plane, for reception on the frame gasket portion 16a on flange 12c and opposed tabs 18e bent back toward the center of the lid part forming a generally a V configuration with the support portion. Tabs 18e on lid part 18b are formed with a cut-out on the curved portion of the bend of the tabs to define catch surfaces 18k lying in the plane of support portion 18d extending into the cut-out for a purpose to be described.

0022. Each lid part is formed with a heater seat in the form of a contact shelf 18f spaced from the plane in which the respective support portion 18c, 18d, lie on the side of the lid parts facing the switch chamber so that the shelves are disposed within the switch chamber 12d when the lids are placed on the housing. Respective side and back walls 18g, 18h are joined to the shelves to ensure a robust seat for maintaining a selected location of a heater element. Shelves 18f are aligned and face each other and are spaced from each other a selected amount to provide direct, close, radiational heat coupling of a heat element received on the shelves with snap acting thermostatic disc 14a.

0023. A heater element in the form of a ceramic substrate 20 has opposed first and second face surfaces 20a, 20b and first and second ends 20c, 20d, respectively. An electrical contact layer 20e of suitable material, such as a silver containing material, preferably formed with external contact bumps, extend across each end 20c, 20d on first face surface 20a and an electrical resistive thick film layer 20f covered by a glass layer is disposed on the first face surface 20a extending between and in electrical connection with the contact layers. The contact layers of the ceramic substrate are adapted to be received on ledges 18f

with the ceramic element closely fitting in the recessed seat and with the heater surface facing thermostatic disc 14a.

0024. A stationary electrical contact 21 is mounted preferably on a platform formed in support portion 18c of lid part 18a on the side of the lid part having shelf 18f. Movable contact 14d is adapted to move into and out of engagement with stationary contact 21 in dependence upon the dished configuration of the thermostatic disc 14a.

0025. A spring clip 22 is formed of suitable material such as stainless steel and generally has an elongated body portion to extend across the width of housing 12 with opposite end portions 22a bent back on themselves to form a generally V configuration with the body portion and a locking tab 22b is struck out from each bent over portion with the free end 22c of the tab extending away from the free end of each locking tab portion 22b. A force application portion in the form of a projection 22e extends away from the body portion of clip 22 on the same side of the clip that end portions 22a are bent to extend.

0026. One terminal 12f extends from housing 12 and another terminal 18m extends from lid part 18b.

0027. Once thermostatic switch 14 is mounted in switch chamber 12d, gasket 16 is slipped onto flange 12c followed by lid parts 18a, 18b with V-shaped tabs 18e slipped over gasket 16, including portion 16b. The lid parts are spaced from one another a selected distance sufficient to ensure electrical separation and with ledges 18f property spaced from each other to receive ceramic substrate 20 thereon with the contact surfaces 20e received on respective shelves 18f. Tabs 18e are then bent inwardly to clamp the lid parts in their selected positions. The ceramic substrate is then inserted and clip 22 is placed over lid portion 18b so that end portions 22a are received over tabs 18e and with struck out locking tab

22b received under respective catch surfaces 18k and with force application portion 22e placing a force on face 20b of ceramic substrate 20.

0028. Fig. 4 shows a modified embodiment 10' in which catch surfaces 18k are formed in lid portion 18a' and clip 22' is formed with a leg portion 22f for positioning force application projection 22e' so that it will be aligned with the center of ceramic substrate 20 when clip 22' is attached to lid part 18a'. Leg 22f may be bent upwardly, as shown in the drawing, for example, along with dashed line 18g, to provide a suitable bias to the ceramic substrate.

0029. Motor protector 10, 10' made in accordance with the preferred embodiments offer a number of advantages over the prior art. The cross section of the heater material is decreased to provide increased resistance making the protector more current sensitive but without loosing robustness. The ceramic substrate adds thermal mass to the heater element to increase the reset time of the thermostatic switch, a feature which is important for certain applications, for example, those with compressors which require an extended cool down time for a PTC starter. Placement of the heater in a recess formed in the switch chamber of the housing provides optimum thermal coupling with the thermostatic switch as well as providing a seat for the heater protected from accidental dislodgement during handling, vibration and the like.

0030. The thick film heater provides a fail safe end of life, i.e., burn out of the heater material or breaking of the ceramic substrate results in an open circuit. Use of the thick film heater also provides an advantage in that the heater film can be trimmed to provide accurate resistance values resulting in accurate time behavior. Further, laser trimming allows more flexibility in defining the nominal resistance value and can be used with the wider range of values than a corresponding coil heater and hence can be used in a wider range of applications.

0031. The use of the spring clip to maintain the ceramic heater in its seat ensures optimum electrical and mechanical connection while avoiding welding or soldering operations.

0032. While the invention has been described in combination with a specific preferred embodiment thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art in view of the foregoing description. It is intended that the invention include all modifications and equivalents of the disclosed embodiment falling within the scope of the appended claims.